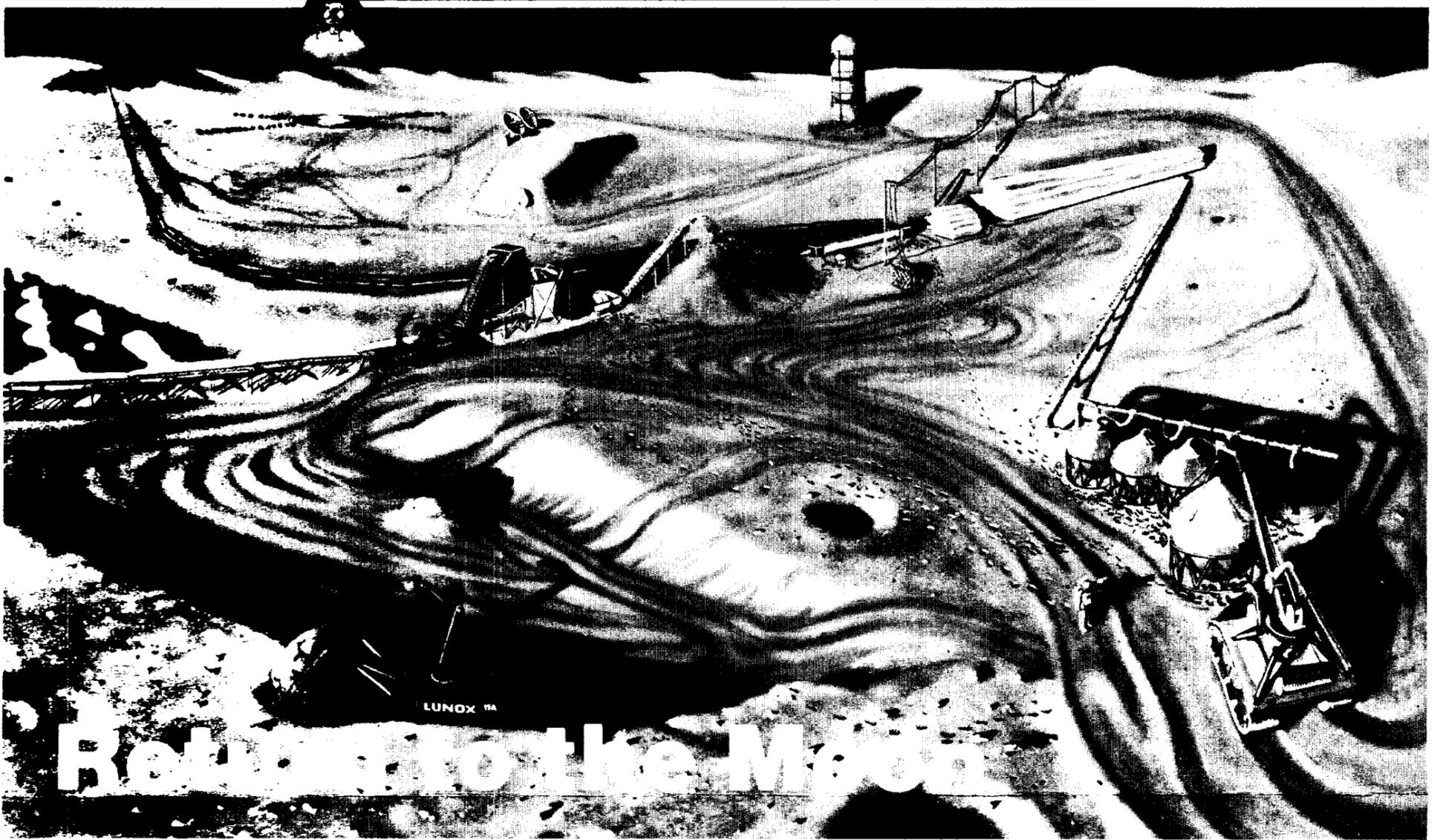


Space News Roundup

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National Aeronautics and Space Administration



Scientists propose initiatives to undertake new lunar ventures. . .

When the United States begins operations in a low Earth orbit space station, a return to the Moon may well become economically and scientifically attractive, scientists say, but not unless new studies are undertaken now to better understand Earth's closest cosmic neighbor.

That was the message sounded during a special session of the 14th Lunar and Planetary Science Conference held at JSC March 14-18.

Through the use of a new lunar geochemical mapper, "it will take six or seven years to get a working data base about the Moon," said JSC scientist Dr. Wendell Mendell. "If we start in Fiscal Year 1985, we can't use that knowledge until the early '90s, precisely when a decision opportunity will come via a U.S. space station."

Such a facility, according to NASA Deputy Administrator Hans Mark, would represent "an enabling technology" for an eventual return to the Moon. Various presentations at the conference highlighted the potential scientific and economic benefits of such a program.

"The Moon is not simple," said Dr. Larry Haskin, Chairman of the Department of Geosciences at Washington University in St. Louis and former chief of the Planetary and Earth Sciences Division here. "There is no water, carbon, nitrogen or free oxygen, but there are potentially valuable amounts of silicon, titanium, aluminum, iron, magnesium, lead, nickel and potassium." Because of the potential value of those mined materials, a scientific/mining base on the Moon ultimately could be self-sufficient and economically prof-

itable, Haskin and others said.

Because only six percent of the Moon has been explored in any kind of detailed way, Mendell, Haskin and others urged that the U.S. adopt a lunar geochemical mapper, designed to orbit the poles, as a top priority in the nation's planetary exploration program. The mapper could provide essential data in geochemistry, mineralogy, geology, heat flow, cartography, gravity and magnetism. All of these disciplines, Mendell said, are "pacing items" which need to be carefully studied before the U.S. can make any decisions about the value of renewed lunar activities. Paul Coleman of the Los Alamos National Laboratory said, "It is clear there is an important need to develop a global picture."

One example of how the Moon could be used was provided by

Hugh Davis of Eagle Engineering. In addition to its ideal qualities as a home for scientific activities, Earth's satellite could also be the source for large quantities of liquid oxygen, Davis said.

Ilmenite, a common, oxygen-rich component of lunar soil, could be mined to produce liquid oxygen. Ferry vehicles, carrying liquid hydrogen from low Earth orbit, would ply the spaceways between Earth and the Moon, dumping off liquid hydrogen at an orbiting lunar base and returning to Earth with liquid oxygen. The two substances, prime fuels of any likely orbital propulsion systems, would then be combined to fuel both the lunar ferries and orbital transfer vehicles.

"Liquid oxygen has been called the petroleum of outer space," Davis said. He added that the system Eagle suggested could

supply 2.35 times as much liquid oxygen as liquid hydrogen brought up from Earth with the Shuttle.

In a way, the system would be a cosmic replay of the triangular trade route which sustained Great Britain during the 17th and 18th Centuries. Each leg — the space station, the lunar base and the satellites in geosynchronous Earth orbit — would benefit from the activities of the other. The plan is preliminary — Eagle Engineering has been working on it just since December — but it illustrates the potential of lunar mining activities.

One of the most eloquent presentations at the session was by Dr. Mark. He stressed before the session that he was speaking as an interested individual, and not necessarily as the number two official in NASA. That said, he

(Continued on page 2)

. . . while a lunar highlands rock is studied here on Earth

While discussion abounded during the 14th Lunar and Planetary Science Conference on a return to the Moon, scientists were also presenting findings which strongly indicate that an Antarctic meteorite found in 1982 is from the Moon, possibly from lunar highlands on the far side.

The one-ounce, golf ball-shaped rock was apparently blasted off the Moon by a large meteorite impact about 100,000 years ago.

Intensive studies conducted during the last several months have come at the same time as scientists in JSC's Planetary and Earth Sciences Division are saying they may also have a piece of Mars, also found in Antarctica (*Space News Roundup*, Dec. 17, 1982). The two discoveries are related, because the mechanisms by which both rocks ended up on

Earth may be similar.

More than 20 groups of scientists from the United States and four foreign countries have analyzed the lunar specimen to try and decide whether it is in fact a lunar rock and how it got from the Moon to the Earth.

The first problem seemed answered by the many papers presented during the conference — the sample looks like a lunar rock. "The people I've talked to range from mildly optimistic to totally convinced," said Dr. Donald Bogard of JSC. "I haven't heard any negative opinions at all."

The specimen was collected in the Antarctic in January 1982 by a joint expedition sponsored by NASA, the Smithsonian Institution and the National Science Foundation. The sample, named ALHA 81005 (ALHA stands for the Allan Hills region where the specimen

was found), was one of about 375 new meteorites picked up that year from the polar ice cap and one of more than 6,000 meteorites found in the Antarctic since active collecting began in 1975.

"It's definitely a meteorite," says Dr. William Cassidy of the University of Pittsburgh, who led the expedition. "It has a fusion crust around it where the outside melted coming through the atmosphere. There is no question that it came from outer space." The uniqueness of ALHA 81005 was recognized from the beginning. John Schutt, the glacial geologist who spotted it, noted the unusual greenish-brown color and frothiness of the glass layer. Beneath the glass, the sample was made up of small fragments of white rock cemented by more glass into a texture unlike that of most meteorites.

"What it looked most like was some of the Apollo 16 breccia samples from the lunar highlands," said Dr. Brian Mason of the Smithsonian Institution's National Museum of Natural History, who made the first microscopic examinations of ALHA 81005 when the sample arrived in the United States last fall.

Dr. Mason's eyeball analysis was confirmed in detail at the conference as scientists presented their extensive analytical results obtained on about a gram (1/28 ounce) of material. After detailed measurements of the mineral composition, chemistry, gas content, radioactivity and other properties, scientists seem unanimous that ALHA 81005 came from the Moon.

No matter what test has been applied, ALHA 81005 looks like the lunar samples returned by the manned Apollo missions and not

like terrestrial rocks or meteorites. For example, the ratios of the elements iron and manganese in pyroxene, one of the minerals found in ALHA 81005, are identical to values measured on lunar samples and very unlike values measured on meteorites. "It's clearly lunar," said Professor Klaus Keil of the University of New Mexico, one of several scientists studying the various minerals and rock fragments in ALHA 81005.

Studies of ALHA 81005's chemistry also point to a lunar origin. "I'm positive it's lunar," said Dr. J. C. Laul of Battelle-Northwest, after only a few days of analytical work. The amounts of about 10 elements in ALHA 81005, including aluminum and the rare-earth metals, are virtually identical to a sample of the lunar highlands (number 15418) returned to Earth

(Continued on page 3)

Space News Briefs

RFP issued for satellite system

The Lewis Research Center has issued a Request for Proposal (RFP) for the design, development, building and launch of the Advanced Communications Technology Satellite (ACTS). The RFP is an invitation to communications satellite builders to bid on the ACTS system, which will consist of a spacecraft, a ground system and operations. Closing date for the proposals is June 3, with contract award anticipated around December of this year. The ACTS system is scheduled for Shuttle launch in 1988 and would be used for communications experiments in a two-year program designed to develop several advanced technologies. Among them would be a new multibeam antenna capable of transmitting signals and receiving them via spot beams from small areas on Earth. This service would allow the transmitting and receiving frequency bands to be reused, increasing the capacity of the system many times. The satellite would also carry an on-board computer to receive, sort, group and store signals from Earth according to their destination, and schedule transmissions accordingly.

Recycling benefits identified

Inhabitants of a future space station could save millions of dollars by growing their own food and recycling refuse, according to a study conducted by the Boeing Aerospace Co. Six different potential NASA missions over the next 50 years were studied, along with three different methods for the provisioning of food and consumables. The three systems were: all food provided by storage and resupply from Earth; plant growth to supply 50 percent of the diet with the remainder supplied by packaged food, with water and oxygen recycled; and plant growth to contribute 97 percent of a vegetarian diet, with the water and oxygen recycled by biological processes. The most effective use of recycling would be in the low Earth orbit space station, the study concluded. Other missions studied included a high Earth orbit space station, a mission to Mars, a lunar base, an asteroid base and a military command post about 132,000 miles out.

Mobile launcher to be modified

The Kennedy Space Center has awarded a contract to a Detroit firm for disassembling the last remaining Saturn V/Apollo launch tower, which now sits atop a mobile launcher platform. The platform will be modified for use in the Space Shuttle program. The three mobile launchers used in the Apollo program were constructed during the mid-1960s. Two have already been modified for use with the Shuttle. Changes have included removal of the umbilical towers and modification of the platform to provide separate exhaust holes for the Shuttle's solid boosters and main engines.

Bulletin Board

'Hail Columbia' to open in Ft. Worth

The Omni Theater in Fort Worth will open to the public April 17 with the Southwestern premiere of "Hail Columbia," a film which has swept critics and viewers off their feet. Produced in the Omnimax format, the film presents the launch of *Columbia* during STS-1 and again during STS-2, projected onto a large tilted dome surrounding the viewer. These high fidelity motion picture systems use a film frame ten times larger than conventional 35 mm film. The 80-foot dome of the Omni theatre is tilted at a 30-degree angle to the horizon to maximize the total viewing area. Behind the dome's vinyl-coated surface, ten speaker clusters — 88 individual speakers driven by 10,000 watts of power — are placed to allow six-track sound to "move" across the theatre in sync with the action on the screen. The Omnimax projector itself stands nearly six feet tall and weighs almost 1,200 pounds. A rolling loop device advances the 70mm film horizontally through the projector in a gentle caterpillar-like wave effect at the rate of 24 frames (nearly six feet) per second. The theater is a new venture for the Fort Worth Museum of Science and History, located at 1501 Montgomery. For more information, contact the museum at (817) 732-1631.

Researchers seek volunteers for tests

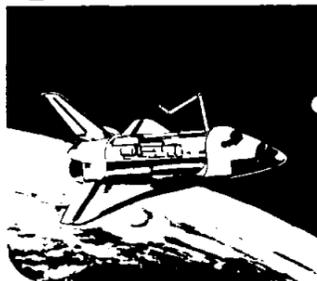
For the first time, the field of medicine is close to discovering the cause and ultimately a treatment for osteoporosis, a loss of calcium in bones which can lead to fractures and chronic disability. Osteoporosis is a common disorder in the U.S., affecting more than 200,000 people of later middle age or older who have hip fractures each year. By age 65, some 25% of all white women have one or more broken bones, and in most cases the diagnosis is osteoporosis. The Medical Research Branch at JSC is recruiting volunteers for tests and measurements which are new and being conducted in only a few large medical centers around the world. The tests involve bone densitometry measurements to measure the amount of bone mineral in the spine and heel. The process takes about one hour and there is no discomfort to the person being tested. The branch is seeking normal men and women, NASA and contractor employees and their families, for the tests. If you are interested, call Cherrie at x5156 for more information. Hours are 9 a.m. to 4 p.m., Monday through Friday.

Astro tickets available

Come out and see the Astros this baseball season with tickets for mezzanine seating at a \$1 discount, available at the Bldg. 11 Exchange Store. Tickets are \$5.50 each except for the April 7 Astros-Pirates game, which will be \$3. Ticket sales will end one week before each game. Tickets are available for the following: April 7, Pirates; April 21, Reds; May 12, Braves; May 25, Cubs; June 9, Giants; July 14, Expos; July 28, Phillies; August 10, Padres; August 29, Cardinals; and September 15, Dodgers.

NASA
Lyndon B. Johnson Space Center

Space News Roundup



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Editor Brian Welch

STS-6 April 4 launch set

After a series of successful tests which have restored "complete confidence in the engines," NASA is pushing for an April 4 launch of the new orbiter *Challenger* for STS-6.

All three main engines, pulled for leak checks and repairs, have been reinstalled and have passed verification tests successfully, according to KSC Launch Operations Director Al O'Hara. "We are very confident that the engines are in excellent condition," he said.

Pre-countdown procedures were scheduled to begin this weekend, with Inertial Upper Stage checks already underway. The call to stations at KSC will come at T-93 hours, or about 2 p.m. EST March 30. On Friday, April 1, the launch team is scheduled to perform final cargo

and payload bay closeouts. A 25-hour hold will commence about midnight Saturday to give most workers at KSC the Easter holiday off.

The final count will pick up again about 1 a.m. Monday, April 4. Launch time is 12:30 p.m. CST. The launch window is nominally 17 minutes, although another 15 minutes could be added launch day if the weather is clear at Dakar, Senegal, the trans-Atlantic abort landing site.

KSC has already begun the deployment of personnel to Edwards Air Force Base, Dakar and White Sands.

Ed Johnson, Assistant STS Launch Director, said particulates which contaminated the Tracking and Data Relay Satellite during a severe storm the night of Feb. 27

were a major reason why the satellite had to be removed for cleaning. Seals around the top of the Payload Changeout Room which conform to the shape of the Orbiter apparently did not hold during the 50 knot winds, and a variety of contaminants filtered down into the payload bay.

In related developments, a new updated solid rocket booster was successfully fired March 21 at a test facility in Utah. NASA and Morton Thiokol officials said preliminary data looked good and all test objectives were met. The test cleared the way for the new high performance boosters on their first launch with the STS-8 vehicle. The motors provide four percent more thrust at liftoff, which translates into a payload capacity increase of about 3,000 pounds.

Return to the Moon

(Continued from page 1)

recalled a sailing cruise off San Francisco in 1972 with the late Dr. Wernher Von Braun. A member of the crew asked Von Braun when the U.S. would return to the Moon, Mark said, and there followed a three-hour "tour de force."

Von Braun compared the exploration of the Moon to the discovery and exploration of Antarctica. "Both are hard to get to, both require life support, and both require large logistics and support," Mark said.

James Cook crossed the Antarctic Circle in 1774, Mark said, and sealing expeditions reached what is now called Palmer Peninsula south of Cape Horn in 1820 and 1821, but it was the 1911 race to the South Pole by two exploration teams which struck Von Braun as analogous to the Apollo 11 mission to the Moon. Robert Falcon Scott and Ronald Amundsen led teams on difficult journeys to the pole. Amundsen reached it first and his team returned to tell the tale. Scott's team starved to death in the Antarctic wastes, only 20 miles from their base camp. Twenty years after that adventure, with national prestige satisfied, not much happened, Mark said.

But in the 1930s, about 20 years later, there came the introduction of what Von Braun called "an enabling technology," the airplane. In a Fokker Tri-Motor, Admiral Richard Byrd of the U.S. Navy explored a great deal of the continent. In 1934, another aerial expedition traveled from coast to coast. Thirty-five years after the Scott-Amundsen race, the United States, in its "postwar exuberance," Mark said, mounted Operation High Jump, a massive effort to explore the continent.



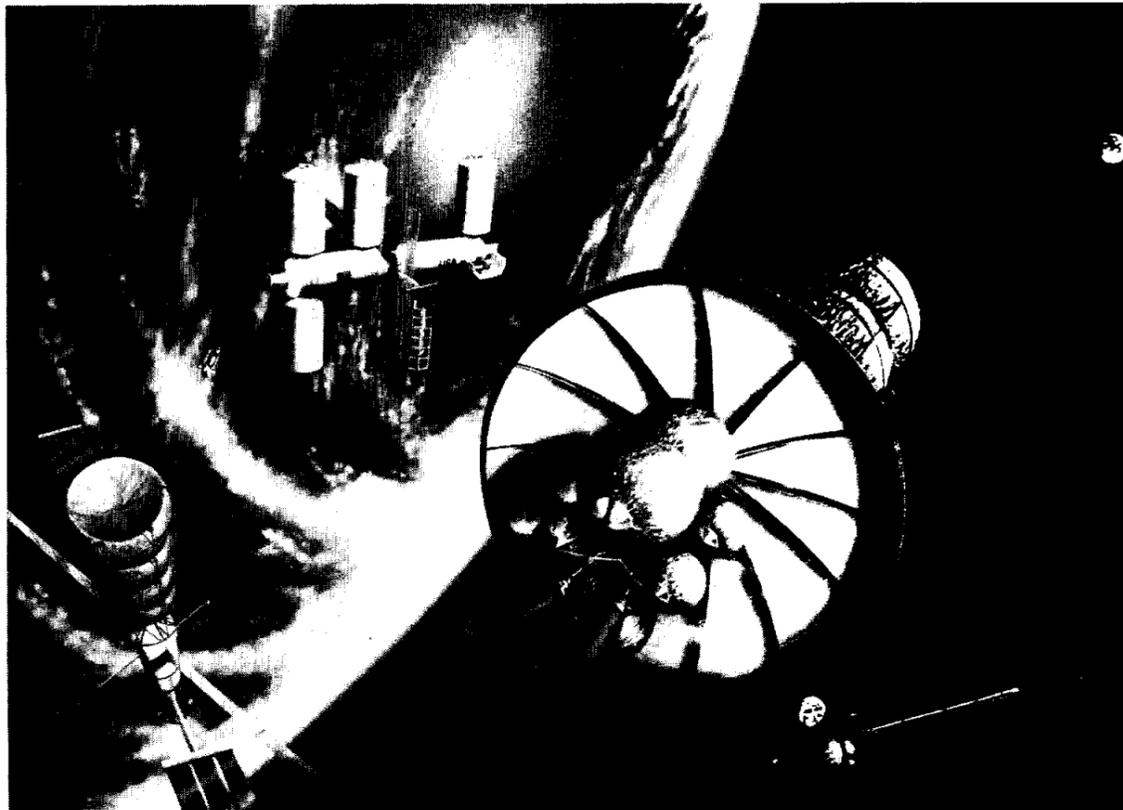
Panel members at the return to the Moon session listen to Dr. Hans Mark's presentation, as does a member of the audience (inset) — former JSC Director Robert R. Gilruth.

More than a dozen ships, three DC-3s and hundreds of people built the U.S. base at McMurdo Sound, and since that time there have always been people living in Antarctica, he said. Today, 70 years after the Amundsen-Scott expeditions, the permanent population of Antarctica is about 1,000, and the summer population is almost 10,000.

Looking to the future, Von Braun had predicted the same sort of enabling technology in space roughly 20 years after Apollo. Mark said the Space Shuttle and a space station might provide it, and

asked, "Where will we be 70 years after 1969? Is it crazy to think that in 2040 the population of the Moon will be over 1,000 people?"

"What we have lacked is the perception that there is an active competition for the utilization of space," said Dr. George Mueller, former NASA Associate Administrator for Space Flight. He said if there is a feeling that there is no need for developing the Moon's potential, "remember, there was no need for the telephone before it was developed, and no need for the printing press before it was invented."



This artist's concept shows a lunar ferry at a low Earth orbit space facility preparing for a trip to the Moon to deliver liquid hydrogen modules. The ferry would use aerobraking on its return to Earth orbit.

Columbia mods proceed for Spacelab

America's first reusable spaceship, the venerable orbiter *Columbia*, has been grounded... but not permanently. The spaceship is now in Bay No. 2 of the Orbiter Processing Facility at the Cape undergoing modifications for the first Spacelab mission later this year.

In general terms, the modifications are relatively minor, given the scope of work to be done after the Spacelab flight, but they will enable *Columbia* to carry the versatile Spacelab, accommodate the six-man crew and will upgrade several systems for added reliability and extended lifetime.

The Spacelab 1 configuration will consist of a two-section pressurized laboratory module, which provides a shirt-sleeve environment for the crew to conduct experiments, and a single U-shaped experiment pallet loaded with various scientific instruments that require direct exposure to space.

Modifications are being made to augment *Columbia's* structural and on-board capabilities to handle requirements of the laboratory, where experiments will be conducted 24 hours a day.

These modifications include the installation of an airlock and tunnel adapter so astronauts can float back and forth between *Columbia's* middeck and the laboratory. Several longeron stabilizer links will be installed in the cargo bay due to Spacelab's load requirements. Oxygen lines will be routed from *Columbia* to the workshop where it will be mixed with Spacelab's own nitrogen system to provide a breathable atmosphere.

To accommodate payload specialists on the flight, airliner-type seats similar to those flown on STS-5 will be installed. *Columbia's* ejection seats will not be removed prior to the Spacelab mission due to the complexity of the task, but will be removed during exhaustive modifications following the Spacelab flight.

Because there will be more people aboard than during any other Shuttle flight, a large number of the modifications are to provide the crew with the comforts of home. A galley will be installed on the middeck to serve as an eating and food storage area. A large rack of developmental flight instrumentation has been removed

to make room for the space age kitchen. A hygiene station will be added to the middeck as well.

Since the crew will work and sleep in 12-hour shifts, three bunks will be installed with sleeping bag restraints. Three hammock-type sleeping bags will also be added to the middeck area. More people also means more equipment, so additional stowage lockers will be added, many of them under the middeck floor.

Changes will be made to cabin flow restrictors to provide adequate breathing air for the larger crew, and portable oxygen systems will be installed for the added crewmen.

To handle additional power requirements, several major changes will be made to the power reactant storage and distribution system. The three standard two sub-stack fuel cells, which provide electrical power to the Orbiter systems, will be replaced with fuel cells that have three sub-stacks, increasing the available voltage. The number of cryogenic storage tanks, which hold and supply super cold reactants to the fuel cells for generating power, and to the environmental control system for air and cabin pressurization, is being increased from three sets to five sets.

A sampling of other modifications include: a new set of stronger main landing gear wheels, plus a modified set of brakes; replacement of from 400 to 600 payload bay insulation blankets with stronger, more heat resistant material; and the replacement of heat-rejecting radiators inside the cargo bay doors with new diffuse coated radiators designed by the Langley Research Center for reduced glare and better heat-rejecting capability.

Other changes include more than 100 black boxes to upgrade *Columbia's* instrumentation systems. The large developmental flight instrumentation pallet, removed for Spacelab, still will not be totally gone. Substantial rewiring will add about 100 former DFI measurements to the Orbiter's Operational Instrumentation System.

A text and graphics unit will be added to the displays. The unit adds the capability of sending

black and white facsimile data to the Orbiter from the ground. It can also receive digital data from the Ku-band signal processor and supply the crew with hard copies of the processed data.

Three of *Columbia's* tactical air navigation (TACAN) units will be replaced with upgraded equipment, and the four quadrant S-band antennas will be replaced with new antennas enabling *Columbia* to communicate with Tracking and Data Relay Satellites (TDRS). The S-band system, which has a larger beam width compared to the narrow pencil beam of the Ku-band system, will be used to lock onto the TDRS. Once the S-band signal is acquired, the Ku-band signal can be turned on.

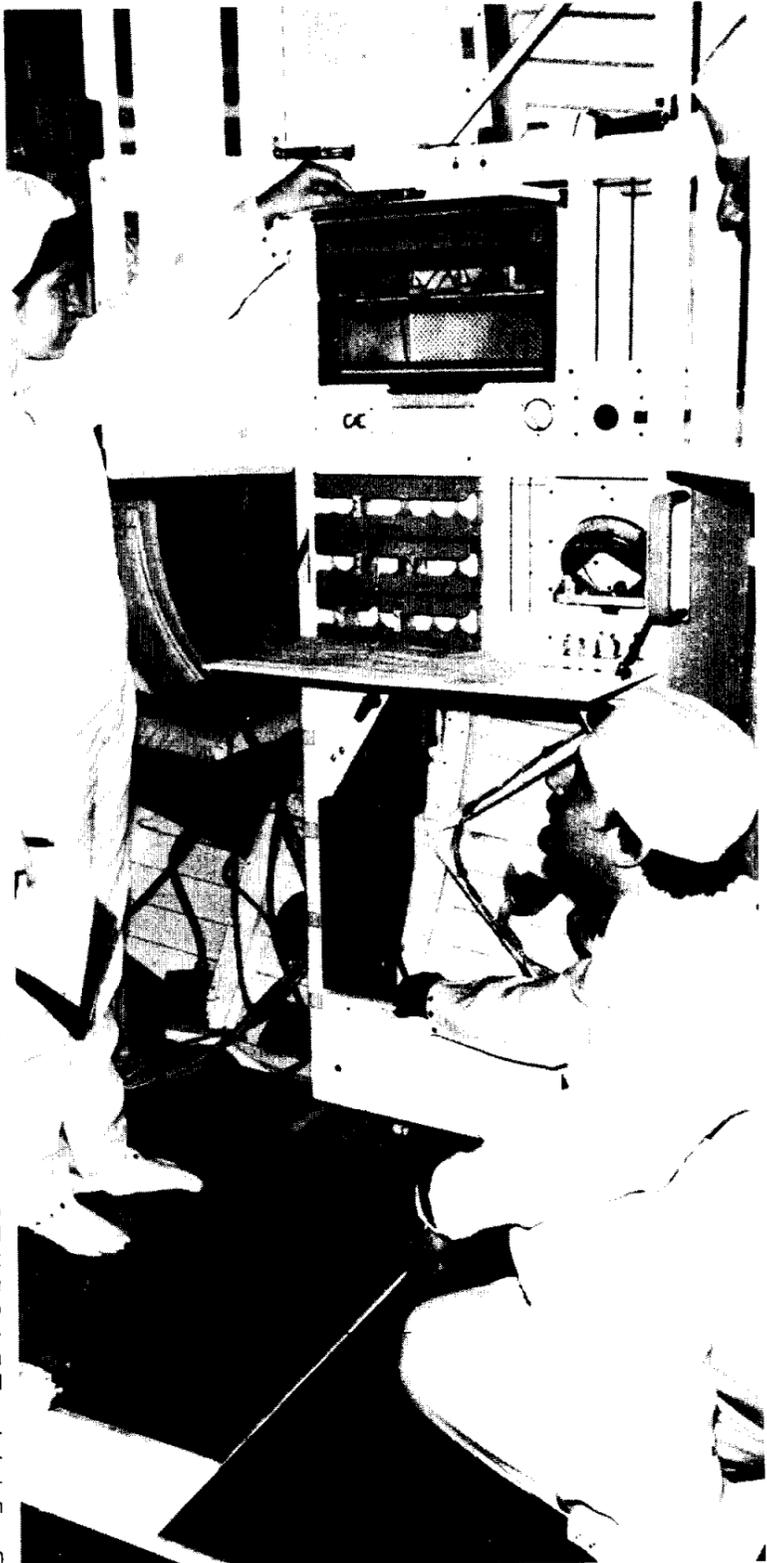
Columbia's engine subsystems are also slated for a thorough going-over. The twin orbital maneuvering system pods and forward reaction control system have been removed and are being processed at KSC's hypergolic maintenance facility. The two orbital maneuvering system engines will be returned to the Aerojet facility and outfitted with new valves qualified for operations.

Columbia will also get a new complement of main engines prior to the Spacelab flight.

While in the OPF, some 2,400 tiles on *Columbia* which have not previously been densified will be removed and strengthened. Ablative panels on the elevons will also be removed and replaced with reusable tiles.

Modification work is scheduled to be completed by June, when tests will begin on the major subsystems in preparation for the flight. Spacelab will be installed in early August and a combined Shuttle/Spacelab interface test will then be conducted. *Columbia* is scheduled for a late August to early September move to the Vehicle Assembly Bldg. for mating with the lightweight external tank and updated solid rocket boosters.

The launch of STS-9 is tentatively scheduled for late September. The mission is a joint venture of NASA and the European Space Agency. Scientists from 11 European nations and from Canada, Japan and the U.S. are providing instruments and experimental procedures for more than 70 different investigations.



Columbia undergoes fit checks in this photo for the galley to be installed for the upcoming Spacelab mission. The galley is a multi-purpose food preparation facility, with an oven which can heat dinner for up to seven people in about 90 minutes at a heating range of from 145 to 185 degrees Fahrenheit.

Lunar highlands rock under study

Sample could shed light on huge unexplored region of the Moon

(Continued from page 1)
by the Apollo 15 mission in 1971.

Studies of the element oxygen in ALHA 81005 provide yet another critical clue to its origin. Meteorites, terrestrial rocks and lunar samples all contain two types of oxygen atoms, one lighter than the other, and the ratio of the two kinds of atoms is different in specimens that come from different planets.

Careful measurements of the oxygen in ALHA 81005 show that it is like lunar and terrestrial samples and not like known meteorites. "Since there is good evidence that it didn't come from Earth," says Professor Robert Clayton of the University of Chicago, describing his analyses, "I'm quite happy to accept a lunar origin."

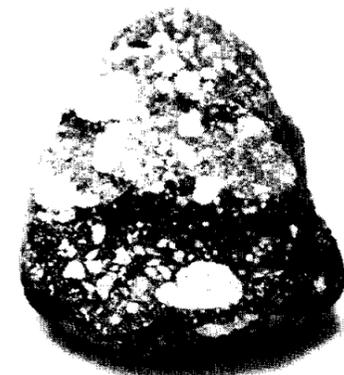
Not only does it appear that ALHA 81005 came from the Moon, it probably sat on the lunar surface for as long as 100 million years before it was blasted to Earth. Rocks exposed at the airless surface of the Moon trap gases emitted from the Sun, and analyses of these gases in ALHA 81005 by Bogard suggest a long residence on the lunar surface. "The amounts of the gases are very much like what we find in other lunar surface

samples, especially the amount of excess argon, but much more than the amount of similar gases found in meteorites," Bogard said.

Bogard's gas analyses are being combined with measurements by Dr. J. C. Evans and his colleagues at Battelle-Northwest, who are studying the weak radioactivity produced in ALHA 81005 by cosmic rays before the rock reached the Earth. The two sets of measurements are being used to construct a history of ALHA 81005's wanderings. "It seems to have been exposed at the surface of the Moon for as much as 100 million years," says Bogard, "which is the kind of result we get for other lunar samples. But the radioactivity data suggest that the sample was buried again for some time before it was ejected and sent to Earth."

The data suggest that the impact that unearthed ALHA 81005 and hurled it towards Earth took place about 100,000 years ago, although the scientists caution that more studies will be needed to pin down the age precisely. Many Antarctic meteorites, which are believed to come from the asteroid belt and not the Moon, have also been on Earth about this long.

The overwhelming evidence of a lunar origin for ALHA 81005 poses problems for some scientists who have argued that meteorite impacts on the Moon would not be able to eject material and send it to Earth. It now ap-



ALHA 81005, thought to be a lunar highlands rock.

pears that such impacts on the Moon can do just that, and a number of people are developing new and better theoretical models of impacts to explain the results.

The conclusions on ALHA 81005 will also strengthen the case that another small group of

meteorites, found both in the Antarctic and elsewhere, were sent to Earth by meteorite impacts on the planet Mars. "These meteorites have characteristics which suggest a large planet as a source, rather than a small asteroid," says Dr. Bevan M. French, NASA's Discipline Scientist for Planetary Materials, "and Mars is an obvious candidate. But the problem is how to get them off Mars and to the Earth. Now that it looks like such a thing did happen on the Moon, it seems much more possible on Mars as well, and I look for a lot of interesting theoretical work on meteorite impact processes in the near future."

Scientists have successfully located the world that ALHA 81005 came from, but it is going to be very hard to pinpoint the spot any closer.

Although ALHA 81005 seems to be a lunar rock and closely resembles other lunar samples, "It's clearly different from what we've seen before," says Keil. "It didn't come from any of the localities we're familiar with." One exciting possibility is that ALHA 81005 might be a piece of the far side of the Moon, the side that never faces Earth. That side of the Moon seems to be composed

almost entirely of highlands-like rocks, but we have never collected a sample. All of the Apollo and U.S.S.R. Luna collections were made on the front side of the Moon. "We may be able to learn a great deal about a huge and unexplored region of the Moon from this one little rock," French comments.

ALHA 81005 is only one of a number of rare and exciting meteorites that have come out of the Antarctic in recent years. Others include two possible meteorites from Mars, a diamond-bearing chunk of iron, several well-preserved carbon-bearing meteorites and a number of unusual rock types. "It's been fascinating to watch the Antarctic meteorite program develop," French says. "When Bill Cassidy started the program, one of his arguments was that, if we could collect a lot of meteorites, we could get a good many rare and unusual types. Everybody agreed with that, but I don't think anyone expected that so many rare and revolutionary samples would be found. I can't wait to see what's in this year's collection." The latest expedition, just completed, collected about 130 meteorites, which should reach the United States this summer.

Gilruth Center News

Call x3594 for more information

Macrame — Learn the basic knots and how to combine them into a decorative piece. Class begins April 13 and meets Wednesdays from 7 to 9 p.m. The cost is \$28 per person for this six-week class.

Intermediate auto mechanics — Learn how to diagnose minor problems with your car before they become major expenses, as well as how to perform normal upkeep. The course features three lectures on Wednesdays from 7:15 to 9:15 p.m. beginning April 13. A Saturday lab will also be offered. Cost for this course is \$45 per person.

Aerobics — This vigorous work-out to music will be offered on Mondays and Wednesdays from 9 to 10 a.m. and Tuesdays and Thursdays from 4:15 to 5:15 p.m. beginning April 4 and 5. Cost for this 12-week course is \$60 per person.

Children's movie — The next movie will be Walt Disney's "Rascal," to be shown from 10 a.m. to noon April 9. The cost will be \$1 per person including popcorn and soft drinks. Tickets are on sale in the Bldg. 11 Exchange Store.

Ladies weight training — Shape up your body in just the right places and gain endurance in this basic course using 10 to 30 lb. weights. The course begins April 4 and runs for six weeks, meeting on Mondays and Wednesdays from 7 to 8 p.m. The cost is \$20 per person.

Yoga — This class is designed for those who desire to gain inner peace, awareness and control of their bodies. The class begins April 6 and runs from 7 to 8 p.m. Cost for this class is \$20 per person.

Beginning oil painting — This class will help students understand the blending of colors and how to attain depth in painting. The course begins April 5 and runs from 7 to 9 p.m. on Tuesdays. Cost for this eight-week course is \$25 per person.

Introduction to symphony — This course is a study of the history and development of the music of the symphony from 1759 to the present. The class will preview a program and attend a symphony concert either as a group or on an individual basis. Class begins April 6 and runs for six weeks on Wednesdays from 7 to 8 p.m. The cost is \$6 per person.

Energetex — This class involves an upbeat, energized routine set to music which is designed to decrease body fat, tone muscles, improve cardiovascular fitness and reduce stress. The class meets on Mondays and Wednesdays from 7 to 8 p.m. The six-week class costs \$20 per person.

Defensive driving — Learn to drive safely and qualify for a 10% reduction in your auto insurance for the next three years. The class meets from 8 a.m. to 5 p.m. Saturday, April 23. The cost is \$18 per person and space is limited.

Aikido — Sharpen your reflexes, improve your self-discipline and strengthen both mental and physical muscles. The class begins April 5 and runs Tuesdays and Thursdays from 5:30 to 7:30 p.m. The cost is \$20 per person.



The JSC Bldg. 2 Auditorium was filled almost to capacity during a special session, "Return to the Moon," during the 14th Lunar and Planetary Conference.

Cookin' in the Cafeteria

Week of March 28 - April 1, 1983

Monday: Cream of Celery Soup; Braised Beef Ribs, Chicken a la King, Enchiladas w/Chili, Italian Cutlet (Special); Navy Beans, Brussels Sprouts, Whipped Potatoes. Standard Daily Items: Roast Beef, Baked Ham, Fried Chicken, Fried Fish, Chopped Sirloin. Selection of Salads, Sandwiches and Pies.

Tuesday: Beef & Barley Soup; Turkey & Dressing, Country Style Steak, Beef Ravioli, Stuffed Cabbage (Special); Corn Cobbette, Okra & Tomatoes, French Beans.

Wednesday: Seafood Gumbo; Catfish w/Hush Puppies, Roast Pork w/Dressing, Chinese Pepper Steak (Special); Broccoli, Macaroni &

Cheese, Stewed Tomatoes.

Thursday: Cream of Tomato Soup; Beef Tacos, BBQ Ham Slice, Hungarian Goulash, Chicken Fried Steak (Special); Spinach, Pinto Beans, Beets.

Friday: Seafood Gumbo; Liver & Onions, Deviled Crabs, Roast Beef w/Dressing, Tuna & Noodle Casserole (Special); Peas, Whipped Potatoes, Cauliflower.

Week of April 4-8, 1983

Monday: French Onion Soup; Beef Chop Suey, Polish Sausage w/German Potato Salad, Breaded Veal Cutlet (Special); Okra & Tomatoes, Green Peas. Standard Daily Items: Roast Beef, Baked Ham, Fried Chicken, Fried Fish, Chopped Sirloin. Selection of Salads,

Sandwiches and Pies.

Tuesday: Split Pea Soup; Salisbury Steak, Shrimp Creole, Fried Chicken (Special); Mixed Vegetables, Beets, Whipped Potatoes.

Wednesday: Seafood Gumbo; Fried Catfish w/Hush Puppies, Braised Beef Ribs, BBQ Plate, Weiners & Beans, Shrimp Salad, Stuffed Bell Pepper (Special); Corn O'Brian, Rice, Italian Breen Beans.

Thursday: Chicken Noodle Soup; Beef Stroganoff, Turkey & Dressing, BBQ Smoked Link (Special); Lima Beans, Buttered Squash, Spanish Rice.

Friday: Seafood Gumbo; Broiled Turbot, Liver & Onions, Fried Shrimp, Meat Sauce & Spaghetti (Special); Green Beans, Buttered Broccoli, Whipped Potatoes.

Roundup Swap Shop

Ads must be under 20 words total per person, double spaced, and typed or printed. Deadline for submitting or cancelling ads is 5 p.m. the first Wednesday after publication. Send ads to AP 3 Roundup, or deliver them to the Newsroom, Building 2 annex. No phone-in ads will be taken. Swap Shop is open to JSC federal and on-site contractor employees for non-commercial personal ads.

Property & Rentals

For lease: Egret Bay 1 BR condo, fireplace, WD, covered parking, view of water, less than 2 years old. Call Actkinson, x4761 or 482-7061.

For sale: three lots at Camelot Forest, Sargent TX, swimming pool, bath house, dock and boat ramp available, \$6,500. Call 474-4942 after 4:30 p.m.

For sale: lot with trees on No. 1 fairway, Texas Nat'l. Golf Course in Willis, below market value. Call Art, x4188.

For rent: Two BR condo at Imperial Lakes, FL, fully furnished, sleeps six, golf, tennis, near Disney World & Cypress Gardens, available Aug. 6-13, \$900. Call 331-0608 after 5 p.m.

For lease: 2-1-1 condo in quiet residential area, \$320/mo. plus deposit, water paid. Call Tam, x4949 or 534-3376.

For sale: 4-2-5-2 brick house in CLC, 4.5 years old, everything first class. Call Al, 486-9220.

For rent: vacation condos in Hawaii, Tahoe, Vegas & Alcapulco, completely furnished, sleep six, \$400 per week. Call Jan, 488-8246 or 482-2667.

For lease: Sun Valley 3-2-2, near Gulf Fwy. and Edgebrook, \$475/mo. plus first and last and deposit, no pets, references. Call 482-8827.

For lease: Camino South 3-2-2, available May 1, \$550/mo. Call 333-2359.

For lease: Forest Bend 3-2-2, fireplace, fenced, playhouse/greenhouse, \$550/mo. Call 485-7436 after 7 p.m.

For rent: Egret Bay 2-2-2 condo, refrigerator, WD, close to NASA, \$480/mo. plus deposit. Call 480-9812 after 5:30 p.m.

For rent: Galveston By-the-Sea condo, 2 BR, furnished apartment for rent by day (2 minimum), weeks or month. Call Clements, 474-2622.

Cars & Trucks

1966 Ford F-100 pickup, runs well, attached camper is equipped with carpet, cupboards, lights, etc., \$600. Call 480-3678 after 6 p.m.

1974 AMC Ambassador, PS, PB, AC, AM/FM/cassette, excellent condition, 45K miles, no rust, \$1,500 firm. Call 332-9040 after 4:30 p.m.

1971 VW Beetle, very reliable, best offer. Call Vickey, 333-6429 or 480-3558 after 5 p.m.

1973 Olds 88 for parts or repair, \$250 or best offer. Call Lewis, x4158 or 480-6321 after 4:30 p.m.

1978 Chevy Malibu, four door, 302 V8, good condition, sell at loan value, \$2,275. Call Anderson, x7204 or 485-3025.

1982 Chevy Celebrity, 4 cyl., 7K miles, auto, air, power, \$6,900. Call 668-3242 or 488-3966.

1967 Ford Mustang, 289 engine, 3-spd., new paint, many new parts, excellent condition, \$1,900. Call 333-3712.

1981 Honda Prelude, air, sunroof, AM/FM/cassette, under 14K miles, immaculate, see to appreciate. Call Dan Mangieri, x5107 or 488-5471.

1977 Nova, extra clean, 4-dr. sedan, AC, excellent engine, five whitewalls, good mpg, manual transmission. Call Barr, x4601 or 485-6074.

1977 Plymouth Volare Premire SW, 68K miles, PB, PS, AC, very good condition, \$1,500. Call Tom Ullrich, x5212 or 487-0307.

1979 Delta 88 Diesel, excellent condition, good mileage, 60K miles, Blue Book \$4,650, asking \$3,800. Call Joanne, x2961.

1978 T-Bird, low miles, excellent condition, PB, PS, AC, cruise, tilt, all electric, \$3,500. Call Ellen, x4441 or 925-7638 after 5 p.m.

1977 Camaro, PS, PB, AC, AM/FM/8-track, good condition, \$2,700. Call 644-8936 after 5 p.m.

1976 Corvette L-48, 4-spd., 58K miles, needs paint, \$6,000. Call 480-1959 after 6 p.m.

1968 Camaro, 327, 4-spd., good condition, \$700 after 6 p.m. Call 554-2416.

1976 Ford Gran Torino, good condition, \$1,500 or best offer. Call McAnelly, x4331 or 332-4732.

1977 Camaro, AM/FM/8-track, AC, power windows and door locks, tilt, 73K miles, good condition, \$3,200. Call Vance, x2321 or Bev, 334-6392.

1976 Capri V6 hatchback, AC, AM/FM stereo, excellent body, low miles, overhauled, \$2,000 or best offer. Call Bill, x3882 or Dave, 488-8595.

1973 Capri V6, wrecked at 20K, excellent right side, engine, transmission, etc. Make offer (cheap). Call Bill, x3882 or Dave, 488-8595.

1982 Toyota Celica GT, hatchback, auto, AC, cruise, AM/FM, sunroof and more, \$8,650. Call Joe, x6226.

1981 Pontiac diesel V8 Gran Prix, air power windows and seats, cruise, tilt, wire wheels, plush interior, \$1,500 down plus what bank will loan. Call Alter, x5111 or 480-9515 after 5 p.m.

1971 Shasta travel trailer, 18 ft., completely self-contained with roof AC, sleeps six, \$2,500. Call 487-0155.

1975 Mustang, 302-V8, AC, PS, AM/FM/cassette, auto, clean, runs great, \$1,200. Call CW, x3101 or 643-8944.

1969 Ford Van, 200 series, radials, AC, FM/tape, 2 captain's chairs, 1 bench seat, been around but still runs great, \$695 or best offer. Call 474-4386.

1980 Cutlass in top shape, will consider trade-in. Call Thompson, 332-2229 after 5 p.m.

Cycles

1976 Honda XL 175, low miles, excellent condition, includes helmet and spare parts, \$450. Call 488-3238 after 6 p.m.

1976 LTD Honda Goldwing, good condition, new air shocks, Vetter fairing, \$1,900. Call Ann, x5827 or 1-925-6634 after 5 p.m.

New motorcycle tires: 460H16, \$37; 510H16, \$40; 510H17, \$40; 350H19 Conti, \$50; several size tubes except 18, \$4 each. Call 488-7899 after 5 p.m.

Assortment of motorcycle batteries. Call 488-7899 after 5 p.m.

1978 Honda XL 25DS, excellent dual purpose street/trail bike, excellent condition, \$625. Call Jim, x6386 or 482-2941.

1980 Kawasaki KZ 750, 4-cyl., Kerker header, excellent condition, \$1,800. Call Jody, 945-6963.

Schwinn tandem bike, \$75, boy's 3-speed, \$15. Call Amell, 488-8682.

Girl's 24" bike (Sears), good condition, \$45. Call Buss, x5867 or 480-2893 evenings.

1972 Honda, 350-4, one owner, new battery, new mufflers, fairing, luggage rack w/backrest, 19K miles, excellent condition, \$700. Call Dan, x5528.

Two 10 speeds, disassembled, plus an old coaster brake bike. \$20 buys the whole mess. Call Steve, x3212.

Two Sears 16" bikes, seat missing on one, \$7 and \$20. Call 474-4386.

Two cycles for the price of one: \$800 buys a 1979 Honda Twinstar and a 1969 Honda 350, or \$600 for the Twinstar and \$225 for the 350. Call Steve, x5111 or 554-2435 after 5 p.m.

Boats & Planes

Victoria 18 sailboat, 81, in good condition. Call Tracy, 482-8425 after 6 p.m.

1979 Pennyan 24', flying bridge, 250hp single 360 Chrysler, tunnel drive, v-berth, galley, head, excellent condition, many extras. Call Don, 554-6733.

Buccaneer 24' cabin sailer, fully loaded and ready to sail, extras included, appraised at over \$10,000 as is, yours for \$7,000. Call 996-9070 after 5 p.m.

Fish/ski boat, 18', 85hp outboard, center console, tri-hull, e-z loader trailer with new tires, 8 years old, needs some work. Call Brooke, x2451.

1971 Venture 24' sail boat, fresh bottom, Woolsey paint, roller furling jib, etc., \$8,000 or best offer. Call Lance, x2896.

Audiovisual & Computers

Radio Shack PC-2 pocket computer with 8K module, \$338 value for 235, used two months. Call 643-8944.

Epson MX-80, 80cps dot matrix printer w/parallel interface, like new, \$375. Call Tom Harmon, x3511 or 480-6075 evenings.

Royce model 606, 23-channel CB with Turner power mike, slide mount and flip flop antenna, excellent condition, \$50. Call Frank, x3836 or 3837.

Pioneer model CT-F650 stereo cassette, seldom used, in the box, \$125 or best offer. Call 480-2439 after 5 p.m.

Household

Couch, canvas/wood frame, \$55; single bed w/cover to convert to sofa, \$40. Call Rn Cohen, x4691.

Sears Coldspot refrigerator, 1976, and GE dishwasher, excellent condition, \$700 or best offer. Call 482-6811 after 7:30 p.m.

Two Danish modern walnut chairs, \$40 each, modern reclining chair, \$60. Call 333-3254.

Paul Bunyan kingsize bed and matching dresser, \$750 or \$500 each; 9 cu. ft. chest freezer, \$225; 1974 Yamaha 500, \$500. Call Jimmy, 486-8153, x173 or 388-2233 after 6 p.m.

Decent used furniture: couches, chairs and coffee table, some need work, low prices. Call Phil, x4691 or 333-5445.

Upright piano, beautiful old Wellington, excellent condition, recently tuned, very good key movement and sound, \$500 or best offer. Call 643-8944.

Beautiful antique piano, burled walnut with wood inlays, brass candlestick mounts, showpiece, \$600 negotiable. Call Steve, x4726 or 482-1734.

Trash compactor, Sears free standing model, used only a few times, clean, \$100. Call Steve, x3212.

Photography

Nikon EM camera with 50, 1.8 E lens, \$115. Call 488-0426 after 6 p.m.

Cannon F-1, 50 mm macro, 24 mm wide angle, 80-200mm zoom, flash, speedfinder, Bellows FL. case, tripod,

X2 converter, matte focus screen, and more for \$1,100. Call Paul Vincent, x3801 or 538-1281 after 5:30 p.m. except Fri.

Wanted

Local baseball/softball league needs additional umpires for 6-10 year age group. Call Gene Peter, 488-4367.

Need a ride to work. Call Hubbard, x3931 or 751-9743.

Want maintenance manual for 1981 VW Rabbit Diesel. Call Dave Dunn, 486-0808.

Want to rent RV to sleep 8-10 adults, for 16 days last half of July. Call 482-7626 or 480-4862 after 5 p.m.

Housemate to share 2-2 apartment at Bay house, \$260/mo. your share. Call Sonya, 333-1211 days.

Want travel trailer, late model, 25 to 27', will pay reasonable price. Call 487-0155.

Want all years of NASA publication, Spinoff. Call Tom Winston, x3836 or 488-7513 after 5 p.m.

Want landscape timbers or railroad ties, will pay reasonable price. Call 480-0279 after 5:30 p.m.

Pets

Beautiful African grey parrot, \$275; Senegal parrot, \$60. Call 481-3731 after 5:30 p.m.

Free to good home: AKC registered female black labrador, about 1.5 years old, partially trained to retrieve. Call Mickey Donahoo, x5276.

Miscellaneous

Auto-wind Seiko watch, blue face, gold plate, gold and silver band, worn twice, perfect condition, \$125 new, sell for \$45. Call Randy, x3594 or 480-5194 evenings.

Wrought iron patio table set, four chairs, round, \$150; ship hatch cover, \$65. Call 488-8682.

Sears 8 hp garden tractor with 36" mowing deck, excellent condition, \$800. Call 538-1597.

Portable 5' X 9' Ho train table layout, \$75; metal building, 7' X 10', disassembled, needs paint, make offer. Call Rudy, x2262 or 946-7028.

For sale: Factory service and overhaul manuals for 1974 Chevy Vega, \$15 or best offer. Call Michele, x3212 or 554-6107.

Victorian open-front doll house kit, never opened, cost \$100, sell for \$35. Call Nancy, x4381.

Diving board, 8' fiberglass, like new condition, \$75. Call Parker, x3781 or 440-4363 after 6 p.m.

Fiberglass top, fits 1976-83 Chevy Blazer, asking \$300, good condition. Call 538-1101 after 6 p.m.